Chemistry II Standards

Unit Title: Advanced Stoichiometry and Nomenclature	**Duration:** 8 weeks

Objectives:
TLW use advanced stoichiometric methods to determine relationships between atoms and molecules in elements, compounds and chemical reactions.
TLW predict the products from the reactants
TLW predict bonding between two atoms of different elements, ions or polyatomic ions
TLW name inorganic compounds as well as write the molecular formula from the name
TLW solve stoichiometric limiting reactant problems
TLW solve combustion analysis problems

Standards:
C5.5A: Predict if the bonding between two atoms of different elements will be primarily ionic or covalent.
5.5B: Predict the formula for binary compounds of main group elements.
5.7A: Recognize formulas for common inorganic acids, carboxylic acids, and bases formed from families I and II.
C5.5B: Predict the formula for binary compounds of main group elements.
C5.7A: Recognize formulas for common inorganic acids, carboxylic acids, and bases formed from families I and II.
C4.2A: Name simple binary compounds using their formulae
C4.2B: Given the name, write the formula of simple binary compounds.
C4.2c: Given a formula, name the compound.
C4.2d: Given the name, write the formula of ionic and molecular compounds.
C4.1a: Calculate the percent by weight of each element in a compound based on the compound formula.
C4.6a: Calculate the number of moles of any compound or element given the mass of the substance.
C4.6b: Calculate the number of particles of any compound or element given the mass of the substance.
C5.2g: Calculate the number of atoms present in a given mass of element.
C5.2A: Balance simple chemical equations applying the conservation of matter.
C5.2B: Distinguish between chemical and physical changes in terms of the properties of the reactants and products.
C5.2d: Calculate the mass of a particular compound formed from the masses of starting materials.
C5.2e: Identify the limiting reagent when given the masses of more than one reactant.
C5.6b: Predict single replacement reactions.
C1.1C : Conduct scientific investigations using appropriate tools and techniques (e.g., selecting an instrument that measures the desired quantity—length, volume, weight, time interval, temperature—with the appropriate level of precision).
C1.1D: Identify patterns in data and relate them to theoretical models.
C1.1h: Design and conduct a systematic scientific investigation that tests a hypothesis. Draw conclusions from data presented in charts or tables.
C5.2e: Identify the limiting reagent when given the masses of more than one reactant.
C5.2A: Balance simple chemical equations applying the conservation of matter.
C5.2B: Distinguish between chemical and physical changes in terms of the properties of the reactants and products.
C5.2d: Calculate the mass of a particular compound formed from the masses of starting materials.
C5.2e: Identify the limiting reagent when given the masses of more than one reactant.

Literacy Activities:
- Close reading of high level, complex text
- Entrance and exit slips
- Teacher/Student Think/Read Aloud

- Complex, Contextual Problem Solving
- Pair & share, group work
- Using the Internet for accurate information acquisition

Skills:

- within the context of lab work, students will be able to follow directions, collect accurate data, use spreadsheets to report accurate results and calculate and identify sources of errors.
- determine from the periodic table the atomic mass of elements and formula mass or molecular mass of various compounds.
- use dimensional analysis to convert between mass, volume of gases and number of species.
- balance chemical reactions
- given reactants, calculate the expected products produced as well as the reactants in excess
- calculate percent yield
- solve limiting reactant problems
- solve combustion analysis problems
- predict products from reactants based on known patterns
- understand why ions form
- understand why ions have a certain charge
- predict oxidation numbers of elements based on the periodic table
- predict how two atoms, ions or polyatomic ions form compounds
- name binary compounds, ternary compounds and acids in both the old and Stock format

Vocabulary:

anion	compound	Stock	empirical formula
bond	element	products	dimensional analysis
cation	ion	reactants	mole
combination	percent yield	single replacement	coefficient
decomposition	acid	theoretical yield	molecular formula
double replacement	binary	atomic mass	percent composition
oxidation number	limiting reactant	avogadro's number	subscript

Unit Title: Gas Laws	**Duration:** 3 weeks

Objectives:
TLW apply the kinetic molecular theory to describe and explain physical and chemical properties of matter and phase changes.
TLW use kinetic molecular theory to describe and explain the behavior of gases.
TLW apply the gas laws to solve advanced complex, contextual gas law problems.

Standards:
C5.2f: Predict volumes of product gases using initial volumes of gases at the same temperature and pressure.
C5.4d: Explain why freezing is an exothermic change of state.
C3.3B: Describe melting on a molecular level.
C2.2A: Describe conduction in terms of molecules bumping into each other to transfer energy. Explain why there is better conduction in solids and liquids than gases.
C2.2B: Describe the various states of matter in terms of the motion and arrangement of the molecules (atoms) making up the substance.
C2.2c: Explain changes in pressure, volume, and temperature for gases using the kinetic molecular model.
C2.2d: Explain convection and the difference in transfer of thermal energy for solids, liquids, and gases using evidence that molecules are in constant motion.
C2.2e: Compare the entropy of solids, liquids, and gases.
C2.2f: Compare the average kinetic energy of the molecules in a metal object and a wood object at room temperature.
C4.4a: Explain why at room temperature different compounds can exist in different phases.
C4.5a: Provide macroscopic examples, atomic and molecular explanations, and mathematical representations (graphs and equations) for the pressure-volume relationship in gases.
C4.5b: Provide macroscopic examples, atomic and molecular explanations, and mathematical representations (graphs and equations) for the pressure-temperature relationship in gases.
C4.5c: Provide macroscopic examples, atomic and molecular explanations, and mathematical representations (graphs and equations) for the temperature-volume relationship in gases.
P4.p1A : For a substance that can exist in all three phases, make a drawing that shows the arrangement and relative spacing of the particles in each of the phase

Literacy Activities:
- Close reading of high level, complex text
- Entrance and exit slips
- Teacher/Student Think/Read Aloud
- Complex, Contextual Problem Solving
- Pair & share, Group work
- Using the Internet for accurate information acquisition

Skills:
- solve advanced complex, contextual gas law problems
- understand the difference between boiling and evaporation
- understand the energy changes associated with phase changes
- understand the difference between heat and temperature
- understand the relationship between molecular motion and temperature

Vocabulary:

atoms	fusion	potential energy

atmosphere boiling point condensation crystallization deposition evaporation freezing point	heat intermolecular kinetic molecular theory kinetic energy Kelvin temperature scale molecules pascal phase	rotational motion STP sublimation thermal contraction thermal expansion translational motion vapor pressure vibrational motion

Unit Title: Major Types of Chemical Reactions and Redox	**Duration:** 3.5 weeks

Objective:

- TLW be able to utilize the major types of reactions

Standards:

C5.6a: Balance half-reactions and describe them as oxidations or reductions.
C5.6c: Explain oxidation occurring when two different metals are in contact.
C5.7B : Predict products of an acid-based neutralization. (prerequisite)
C5.7f: Write balanced chemical equations for reactions between acids and bases and perform calculations with balanced equations.

Literacy Activities:

- Close reading of high level, complex text
- Entrance and exit slips
- Teacher/Student Think/Read Aloud
- Complex, Contextual Problem Solving
- Pair & share, Group work
- Using the Internet for accurate information acquisition

Skills:

- differentiate between combination, decomposition, single and double replacement reactions and use these patterns to predict chemical reactions
- differentiate between molecular, ionic and net ionic chemical equations.
- differentiate between precipitation, neutralization and redox reactions
- solve complex, contextual redox and titration problems.
- identify the oxidized and reduced species
- identify the oxidizing and reducing species

Vocabulary:

anion	compound	oxidation number
bond	element	polyatomic ion
cation	ion	single replacement reactions
combination reactions	decomposition reactions	double replace reactions
ionic equation	molecular equation	oxidation
net ionic equation	redox	reduction
oxidizing species	reducing species	spectator ions
salt	acid	base
neutralization reaction	titration	precipitation reaction

Unit Title: Thermochemistry	**Duration:** 2.5 weeks

Objective:
TLW measure, calculate, and diagram energy transfer for chemical reactions and relate entropy and enthalpy to determine the spontaneity of reactions

Standards:
C3.1a: Calculate the ΔH for a given reaction using Hess's Law.
C3.4d: Draw enthalpy diagrams for reactants and products in endothermic and exothermic reactions.
C3.4e: Predict if a chemical reaction is spontaneous given the enthalpy (ΔH) and entropy (ΔS) changes for the reaction using Gibb's Free Energy, $\Delta G = \Delta H - T\Delta S$ (Note: mathematical computation of ΔG is not required.)
C3.4f: Explain why some endothermic reactions are spontaneous at room temperature.

Literacy Activities:
- Close reading of high level, complex text
- Entrance and exit slips
- Teacher/Student Think/Read Aloud
- Complex, Contextual Problem Solving
- Pair & share, Group work
- Using the Internet for accurate information acquisition

Skills:
- calculate the ΔH for a given reaction using Hess's Law.
- write chemical equations including the heat term as a part of equation or using ΔH notation.
- calculate the amount of heat produced for a given mass of reactant from a balanced chemical equation
- draw enthalpy diagrams for exothermic and endothermic reactions.
- predict if a chemical reaction is spontaneous given the enthalpy (ΔH) and entropy (ΔS) changes for the reaction and explain why some endothermic reactions are spontaneous at room temperature

Vocabulary:

system	surroundings	internal energy
PV work	work	heat energy
exothermic	endothermic	joule
calorie	state function	enthalpy
calorimetry	heat of reaction	heat of combustion
heat of formation	stand heats of reaction	

Unit Title: Electronic Configurations	**Duration:** 2 weeks

Objective:
TLW describe the energy of electrons according to quantum theory and express the organization of the electron using electron configuration and kernel structures.

Standards:
C4.10A: List the number of protons, neutrons, and electrons for any given ion or isotope.
C4.10B: Recognize that an element always contains the same number of protons.
C4.10e: Write the symbol for an isotope, X Z A , where Z is the atomic number, A is the mass number, and X is the symbol for the element.
C4.8A: Identify the location, relative mass, and charge for electrons, protons, and neutrons
C4.8B: Describe the atom as mostly empty space with an extremely small, dense nucleus consisting of the protons and neutrons and an electron cloud surrounding the nucleus.
C4.8C: Recognize that protons repel each other and that a strong force needs to be present to keep the nucleus intact.
C4.8e: Write the complete electron configuration of elements in the first four rows of the periodic table.
C4.8f: Write kernel structures for main group elements.
C4.8h: Describe the shape and orientation of s and p orbitals.
C4.8i: Describe the fact that the electron location cannot be exactly determined at any given time.
C4.9A: Identify elements with similar chemical and physical properties using the periodic table.

Literacy Activities:
- Close reading of high level, complex text
- Entrance and exit slips
- Teacher/Student Think/Read Aloud
- Complex, Contextual Problem Solving
- Pair & share, Group work
- Using the Internet for accurate information acquisition

Skills:
- describe and explain the modern view of an atom
- write quantum numbers for electrons
- write electronic configurations for the elements
- understand and draw the orbital shapes of the different types of orbitals
- explain chemical periodicity based on electron configurations
- use the pauli exclusion principle
- write the energy states of electrons
- understand and use Hund's rule

Vocabulary:

absorption spectrum	emission spectrum	orbital	relative energy
atomic motion	energy level	p orbital	release of energy
Bohr	excited state	probability	s orbital

bright-line spectrum	flame test	quantum energy	sublevel
chemical bond	ground state	quantum mechanics	sublevel
electromagnetic field	kernel	quantum numbers	valence electron
electromagnetic wave	kernel structure	quantum theory	wave amplitude
electron configuration			

Unit Title: Lewis Structures and Molecular Shape	**Duration:** 3 weeks

Objectives:
TLW predict bonding between two atoms of different elements and classify bonds as ionic, covalent, or polar covalent; and explain intermolecular forces
TLW be able to draw Lewis structure of molecules and use those structures to generate a 3D drawing of the expected shape of the molecule

Standards:
C4.3A: Recognize that substances that are solid at room temperature have stronger attractive forces than liquids at room temperature, which have stronger attractive forces than gases at room temperature.
C4.3c: Compare the relative strengths of forces between molecules based on the melting point and boiling point of the substances.
C4.3d: Compare the strength of the forces of attraction between molecules of different elements. (For example, at room temperature, chlorine is a gas and iodine is a solid.)
C4.3e: Predict whether the forces of attraction in a solid are primarily metallic, covalent, network covalent, or ionic based upon the elements' location on the periodic table.
C4.3f: Identify the elements necessary for hydrogen bonding (N, O, F).
C4.4b: Identify if a molecule is polar or nonpolar given a structural formula for the compound.

Literacy Activities:
- Close reading of high level, complex text
- Entrance and exit slips
- Teacher/Student Think/Read Aloud
- Complex, Contextual Problem Solving
- Pair & share, Group work
- Using the Internet for accurate information acquisition

Skills:
- writing Lewis structures of elements and compounds
- using Lewis structures, draw 3D pictures of molecules
- determine polarity of bonds and molecules

Vocabulary:

covalent compounds electronegativity pi bonds intramolecular	intermolecular ionic compounds metals metalloids	nonmetals polarity sigma bonds

Unit Title: Acids and Bases	**Duration:** 3 weeks

Objective:
Using acid-base theory, TLW write equations for various acid-base reactions and determine the pH and concentration of various samples.

Standards:
C5.7A: Recognize formulas for common inorganic acids, carboxylic acids, and bases formed from families I and II.
C5.7B : Predict products of an acid-based neutralization.
C5.7D: Classify various solutions as acidic or basic, given their pH.
C5.7f: Write balanced chemical equations for reactions between acids and bases and perform calculations with balanced equations.
C5.7g: Calculate the pH from the hydronium ion or hydroxide ion concentration.
C5.r1a: Predict how the rate of a chemical reaction will be influenced by changes in concentration, temperature, and pressure.
C5.r1b: Explain how the rate of a reaction will depend on concentration, temperature, pressure, and nature of reactant.
C5.r7i: Identify the Brønsted-Lowry conjugate acid-base pairs in an equation.

Literacy Activities:
- Close reading of high level, complex text
- Entrance and exit slips
- Teacher/Student Think/Read Aloud
- Complex, Contextual Problem Solving
- Pair & share, Group work
- Using the Internet for accurate information acquisition

Skills:
- define and identify acids and bases
- know strong acids and bases
- understand and use the equilibrium constant for aqueous solutions
- understand and use the pH and pOH scale
- solve complex, contextual strong acid-base problems
- solve complex, contextual dilution problems
- solve complex, contextual acid-base neutralization problems
- solve complex, contextual acid-base titration problems
- solve complex, contextual weak acid-base problems
- Identify the Brønsted-Lowry conjugate acid-base pairs in an equation.

Vocabulary:

acid	basic	hydroxide	neutralization
acid-base reaction	Bronsted-Lowry	ion	neutralize
acidic	carboxyl group	ionization	pH
alkaline	hydrogen ion	molarity	salt

acidic	Bronsted-Lowry acid	conjugate acid	Lewis acid
Arrhenius acid	Bronsted-Lowry base	conjugate base	pOH
Arrhenius base	buffer	ionization constant (Ka, Kb, Kw)	ternary acid
binary acid			

Unit Title: Organic Chemistry	**Duration:** 3 weeks

Objectives:
TLW draw and name structural formulas and isomers for simple hydrocarbon chains and recognize biological polymers.
TLW identify common functional groups as well as know their general properties

Standards:
C5.8A: Draw structural formulas for up to ten carbon chains of simple hydrocarbons.
C5.8B: Draw isomers for simple hydrocarbons.
C3.2b: Describe the relative strength of single, double, and triple covalent bonds between atoms.
C2.r5d: Describe how and where all the elements on earth were formed.

Literacy Activities:
- Close reading of high level, complex text
- Entrance and exit slips
- Teacher/Student Think/Read Aloud
- Complex, Contextual Problem Solving
- Pair & share, Group work
- Using the Internet for accurate information acquisition

Skills:
- identify organic molecules
- understand and use structural complexity of organic compounds
- understand and use the different forms of isomerisms
- draw hydrocarbons
- name alkanes, alkenes, alkynes, cyclical and aromatic compounds
- identify the main functional groups

Vocabulary:

alkane	carbon	chemical bond	organic compound
alkene	carbon bonds	double bond	polymer
alkyne	carbon chain	hydrocarbon	structural formula
bond energy	carbon chemistry	isomer	synthetic polymer
branching network of carbon atoms	carbon ring	monomer	
alcohol	amine	ester	ether
aldehyde	carboxylic acid	ethene	ketone